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Program Demonstration Update

Performance Verification of Sediment Sampling Technologies

Introduction

The U.S. Environmental Protection Agency (EPA) identifies new technologies for hazardous waste sampling, characterization, and cleanup through its Superfund Innovative Technology Evaluation (SITE) Program. Created in 1986, this program has four primary objectives: (1) identify and remove obstacles to development and commercial use of innovative technologies, (2) support a development program that identifies and nurtures emerging technologies, (3) demonstrate promising innovative technologies to establish reliable performance and cost information for site characterization and cleanup decision-making, and (4) develop procedures and policies that encourage selection of innovative technologies for Superfund sites as well as other sites and commercial facilities.

Two sediment sampling technologies are to be demonstrated under EPA's SITE Program: Art's Manufacturing & Supply, Inc.'s (AMS), Split Core Sampler for Submerged Sediments and Aquatic Research Instruments' (ARI) Russian Peat Borer. The technology demonstration is a cooperative effort of the SITE Program and EPA Regions 1 and 5.

The SITE Program

The SITE Program includes the following elements: the Monitoring and Measurement Technology (MMT) Program, the Remediation Technology Program, and the Technology Transfer Program. The innovative sediment sampler demonstration is being conducted as part of the MMT Program, which is briefly described below.

The MMT Program provides developers of innovative hazardous waste measurement, monitoring, and sampling technologies an opportunity to demonstrate the performance of their technology under actual field conditions. These technologies may be used to detect, monitor, sample, or measure hazardous and toxic substances in soil, sediment, waste material, and groundwater.

The technologies include chemical sensors for *in situ* (in place) measurements, groundwater samplers, soil and sediment samplers, soil gas samplers, laboratory and field-portable analytical equipment, and other systems that support field sampling or data acquisition and analysis.

The MMT Program strives to achieve the following objectives:

- Test field analytical technologies that enhance monitoring and site characterization capabilities
- Identify performance attributes of innovative technologies to address field characterization and monitoring problems in a cost-effective and efficient manner
- Prepare protocols, guidelines, methods, and other technical publications that enhance acceptance of these technologies

The MMT Program is administered by the Environmental Sciences Division, National Exposure Research Laboratory in Las Vegas, Nevada.

Purpose and Scope of the Demonstration

The demonstration of the AMS Split Core Sampler for Submerged Sediments and the ARI Russian Peat Borer will be conducted under the MMT Program during the last week of April and the first week of May 1999 at sites in EPA Regions 1 and 5. The purpose of the demonstration is to obtain reliable performance and cost data on these innovative samplers in order to provide (1) a better understanding of innovative sediment samplers that may be more versatile, more cost-effective, and faster to use than conventional sediment samplers and (2) an opportunity for the innovative sediment samplers to enter the marketplace and compete with conventional samplers without long delays.

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AMS Split Core Sampler for Submerged Sediments

The AMS Split Core Sampler for Submerged Sediments is designed to collect undisturbed, cylindrical core samples of various types of sediment, including saturated sands and silts, up to a maximum depth of 36 inches below the sediment surface (bss). The sampler is designed to collect sediment with a particulate diameter not exceeding 2/3 inch. The AMS Split Core Sampler for Submerged Sediments is a modified version of the AMS Split Core Sampler, which is commonly used to collect undisturbed soil samples.

Technology Description

Components of the AMS Split Core Sampler for Submerged Sediments include (1) up to three 12-inch-long pairs of 300-series, stainless-steel split core cups with interlocking, recessed channels and male, square-threaded ends; (2) a 400-series, stainless-steel coring tip; (3) a rigid plastic basket retainer; (4) a ball check valve-vented top cap; (5) a female, square-threaded coupling for attachment to additional stainless-steel split core cups; and (6) stainless-steel or 4130 Alloy AMS extensions available in 3-, 4-, and 5-foot lengths (see Figure 1). The sampler can be operated with the AMS Slide-Hammer, the stainless-steel or rubber-coated AMS Cross Handle, or the AMS Electric Hammer Drill. Also, the sampler may be used with a core tube liner available in plastic, stainless steel, brass, aluminum, and Teflon® to facilitate removal of an intact sample from the split core cups. Ancillary components for operation of the sampler include crescent wrenches and slip wrenches for assembly of the sampler, core caps for enclosing a sediment core within the core tube liner, the AMS Sample Preparation Station for splitting core tube liners and examining samples, and the AMS Tripod Winch for recovering the sampler during sampling.

The assembled AMS Split Core Sampler for Submerged Sediments has an inside diameter of 2 inches and is designed to collect sample volumes of 620; 1,240; and 1,860 milliliters (mL) using one, two, and three pairs of interlocking split core cups, respectively. The fully equipped sampler, including one pair of 2-inch-diameter split core cups, the top cap with the ball check valve, the coring tip, the coupling, and the basket retainer, weighs about 7.5 pounds. The AMS Slide-Hammer weighs about 10.2 pounds.

The AMS Split Core Sampler for Submerged Sediments can be either manually pushed into sediment using the AMS Cross Handle or hammered into sediment using the AMS Slide-Hammer or Electric Hammer Drill. The ball check valve in the sampler's top cap allows water to exit the sampler during deployment and creates a vacuum to help retain a sediment core during sampler retrieval. Also, the basket retainer is designed to help retain sediment within the interlocked split core cups. The sampler can be retrieved manually, by reverse hammering using the AMS Slide-Hammer, or using the AMS Tripod Winch.

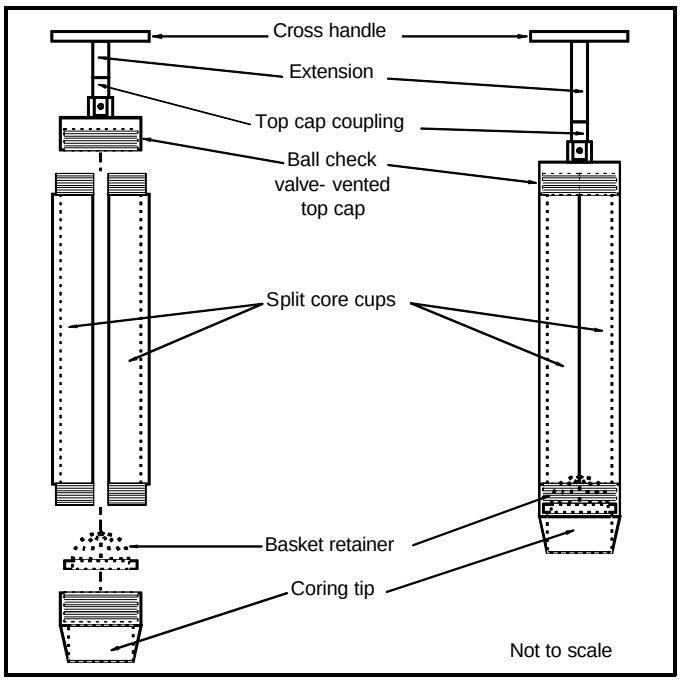

Figure 1. AMS Split Core Sampler for Submerged Sediments.

According to AMS, the Split Core Sampler for Submerged Sediments is innovative because it incorporates a ball check valve in the top cap to allow water to escape as the sampler is deployed and to prevent water from entering the sampler as it is retrieved. Also, the coring tip of the sampler has been modified from earlier versions of the sampler to accommodate a basket retainer designed to help prevent sample loss as the sampler is retrieved.

Operating Procedures

The AMS Split Core Sampler for Submerged Sediments can be operated by one person from a platform, from a boat, or while wading in shallow water. Depending on sampler decontamination requirements and sampling conditions such as water depth and sediment type, the stainless-steel AMS extensions or the stronger, more widely used 4130 Alloy AMS extensions can be attached to the sampler before its deployment. The fully assembled sampler is manually lowered into the water in such a way that the coring tip is placed on the sediment surface. The sampler can then be either manually pushed with the AMS Cross Handle or driven with the AMS Slide-Hammer to the desired sediment depth. The sampler is removed from the sediment either manually or by reverse hammering using the AMS Slide-Hammer. The sampler is raised out of the water manually or using the AMS Tripod Winch. Once the sampler has been retrieved, the interlocking split core cups are separated from the extensions and carefully opened. The sediment core enclosed in the core tube liner, if used, can be either sealed in the core tube using two core caps or removed. The core is removed by splitting the liner with a knife or using the AMS Sample Preparation Station.

ARI Russian Peat Borer

The ARI Russian Peat Borer is a manually driven core sampler designed to consistently collect uncompressed samples of bog and marsh sediment. The sampler is designed to operate in shallow water (a depth of up to 15 feet) and to achieve complete sediment profile collection to a maximum depth of 65 feet bss, depending on the sediment thickness.

Technology Description

Components of the ARI Russian Peat Borer include a stainless-steel core tube; 1-inch-diameter, aluminum extension rods with a stainless-steel coupling nut; a stainless-steel turning handle; and a Delrin® core head and bottom point that support a stainless-steel cover plate. The cover plate is curved and sharpened to minimize disturbance when the sampler is inserted into sediment (see Figure 2). The core tube is hinged to the cover plate by two stainless-steel pivot pins at the top and bottom of the plate. Support equipment for operation of the sampler may include a slide-hammer mechanism or 10-foot-long, magnesium-zirconium rods that are each 1.3 inches in diameter.

The ARI Russian Peat Borer is available in two separate models with 20- and 40-inch core tube lengths. The two models are designed to collect maximum sample volumes of 500 and 1,000 mL, respectively. The fully assembled samplers without extension rods weigh about 5.5 and 15 pounds, respectively. Each additional 40-inch-long extension rod weighs about 2 pounds.

The ARI Russian Peat Borer is manually inserted into sediment in the beginning position and turned 180 degrees clockwise. This procedure allows the sharp edge of the core tube to rotate and longitudinally cut through the sediment, collecting a semicylindrical sediment core 2 inches in diameter. While the core tube is manually turned, the stainless-steel cover plate provides support so that the collected material is retained within the core tube.

According to ARI, the Russian Peat Borer is innovative because the core head and bottom point are made of Delrin®, a thermoplastic polymer that has a high modulus of elasticity as well as strength, stiffness, and resistance to abrasion and the degrading effects of moisture. Earlier sediment samplers with a similar design were typically made entirely of stainless steel. ARI has also installed a rubber strip on the cover plate of its sampler to create a seal that prevents loss of collected material from the core tube when it is in the closed position. In addition, ARI limited the thickness of the cover plate and the core tube to 2 millimeters in order to minimize the resistance created by the sediment during sampler deployment and core tube rotation. Finally, according to ARI, the optional, 10-foot-long, magnesium-zirconium rods available for sampler deployment to depths greater than 50 feet bss are durable, light in weight, and easily coupled and uncoupled in cold weather.

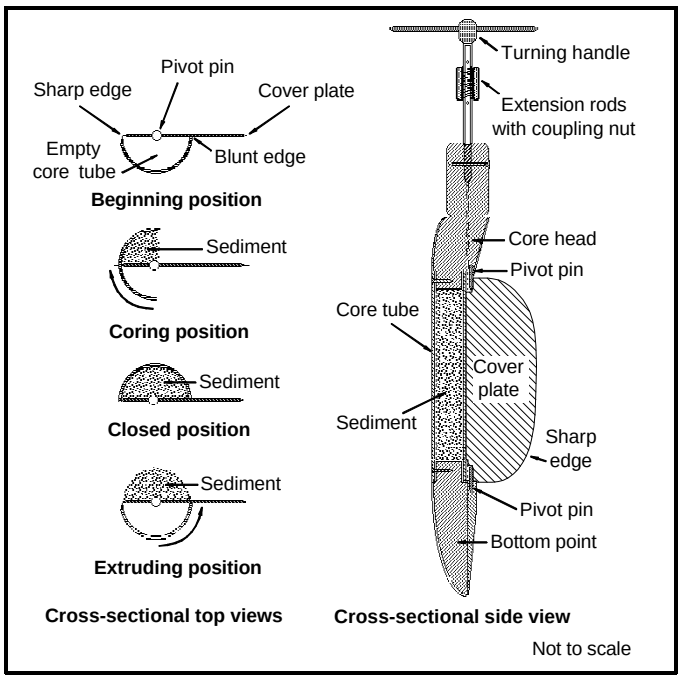

Figure 2. ARI Russian Peat Borer.

Operating Procedures

The ARI Russian Peat Borer can be operated by one person from a platform, from a boat, or while wading in shallow water. Figure 2 includes a four-stage depiction of the sampler operating procedures. The sampler is operated by manually inserting the bottom point into sediment with the blunt edge of the core tube turned against the cover plate to prevent sediment from entering the core tube during penetration. A slide-hammer mechanism can be used to drive the sampler to a depth of up to 65 feet bss. Once the sampler is driven into the sediment to the desired depth, the turning handle is manually turned 180 degrees clockwise, allowing the sharp edge of the core tube to longitudinally cut through the sediment. During rotation of the core tube, the cover plate stabilizes the collected material. The sampler reaches the closed position when the sharp edge of the core tube is in contact with the cover plate.

Once it is in the closed position, the ARI Russian Peat Borer can be manually retrieved. As the sampler is retrieved, a constant, clockwise pressure on the sampler is required to ensure that the core tube remains in the closed position. After retrieval, the turning handle and extension rods are removed, and the core tube is manually turned counterclockwise to expose the semicylindrical core sample on the cover plate.

To allow consecutive, complete reconstruction of a long sediment profile, two ARI Russian Peat Borers should be alternately deployed side-by-side to alternating depths. This procedure is designed to minimize disturbance to the sediment while a complete, continuous sediment core is collected.

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The demonstration has both primary and secondary objectives. The primary objectives are critical to the technology evaluations and require use of quantitative results to draw conclusions regarding technology performance. The secondary objectives pertain to information that is useful but do not necessarily require use of quantitative results to draw conclusions. The demonstration has the following primary objectives:

- Evaluate whether the samplers can consistently collect a specified volume of sediment
- Determine whether the samplers can consistently collect samples at a specified depth interval
- Assess the samplers' ability to collect multiple samples with consistent physical or chemical characteristics, or both, from a homogenous layer of sediment
- Evaluate whether the samplers can collect a representative sample from a "clean" sediment layer that is below a contaminated sediment layer
- Assess the samplers' ability to be adequately decontaminated between sampling areas
- Measure the time required for each activity associated with sample collection (sampler setup, sample collection, sampler disassembly, and sampler decontamination)
- Estimate costs associated with sample collection activities (capital, labor, supply, investigation-derived waste disposal, and support equipment costs)

The secondary objectives of the demonstration are as follows:

- Document the skills and training required to properly operate the samplers
- Evaluate the samplers' ability to collect samples under a variety of site conditions
- Assess the samplers' ability to collect an undisturbed sample
- Evaluate the samplers' durability based on their materials of construction and engineering designs
- Document the availability of the samplers and spare parts

The performance and cost of each innovative sampler will be compared only to those of a reference sampler (that is, a conventional sediment sampler); innovative samplers will not be compared to other innovative samplers. A Hand Corer will be used as the reference sampler in EPA Region 1, and a Vibrocorer will be used as the reference sampler in EPA Region 5.

After the demonstration is complete, EPA will publish innovative technology verification reports for the innovative sediment samplers. The reports will be completed by the end of 1999.

Site Descriptions

The two innovative sediment samplers will be demonstrated at sites in EPA Regions 1 and 5. At the Region 1 site, demonstration sampling activities will be conducted in two areas. One area represents open-water conditions; water flow is low, and water depth is about 10 feet. The other area is in a low-lying wetland; water flow in this area is low to moderate, and water depths range from 0.2 to 2 feet.

At the Region 5 site, demonstration sampling activities will be conducted in two river environments. One sampling area represents open-water conditions: the water flow is low to moderate, and its depth is about 5 feet. The second sampling area has a very slow-moving current and a water depth of about 2.5 feet.

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